Product Design Specifications

Neck Extender and Flexor for Fluoroscopy Examinations

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Client
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Problem Statement: Our project involves creating a motorized neck positioner for a patient during fluoroscopy examination. The device must extend and flex the neck and cannot interfere with lateral radiographic imaging. This facilitated extension and flexion will aid in diagnosing ligament injuries.

Client Requirements:

- Extend and flex the neck +/- 45^{o} from neutral
- Operate at less than 2^{o}/sec
- Stabilize patient's head during motion
- No interference with lateral fluoroscopic imaging

Design Requirements:

Physical and Operational Characteristics

a. Performance Requirements
   - Operational by one person (preferably by remote control, or at a distance)
   - Motion should be smooth, to prevent further patient injury
   - Must flex and extend the neck +/- 45^{o} from horizontal
   - Must be able to determine angle of elevation of neck, either mechanically or digitally
   - Operate at less than 2^{o}/sec
   - Only move the head and neck of the patient.
   - No interference with fluoroscopy or the operation of the fluoroscopy machine

b. Safety
   - No sharp edges, corners, hinges that could pinch or tear
   - Stable at all times
   - Smooth movement to prevent further patient injury
   - Emergency stop (panic button)

c. Accuracy and Reliability
   - Angle measurement must be accurate within +/- 5^{o}
d. Life in Service
   - Must last for an extended period of time (5 years)
e. Shelf Life
   - Storable in room temperature
   - Functional after extended periods of idle time
   - Require minimal maintenance
f. Operating Environment
   - Tolerate repeated exposure to x-rays from fluoroscopic imaging
   - Withstand wear and tear from operation and movement by hospital staff
   - Circuitry protected from damage due to humidity, fluid spills, temperature, or other adverse conditions
g. Ergonomics
   - Operation controls outside of range of the fluoroscopy scan
   - Easy to position patient on device
h. Size
   - Appropriately fitted to dimensions of fluoroscopy examination table
   - Easily removable and storable
   - Easy maintenance and modification
i. Weight
   - Less than 20lb, so it can be handled by staff
   - Heavy enough to ensure stable operation
j. Materials
   - Metallic and/or dense materials are not permissible in the area of examination (will interfere with X-ray signal)
k. Aesthetics, Appearance, and Finish
   - Fit under or above fluoroscopy table, but beneath hospital pad on table
   - Similar color and material as fluoroscopy table and pad (white and grey)
   - Smooth edges and texture to prevent injury during examination and handling
   - Able to be sterilized between patients without damage to components.

Production Characteristics

a. Quantity
   - One prototype, can be a larger scaled model of actual device
   - Potential to mass produce if marketable
b. Target Production Cost
   - Less than $250 for prototype
   - At most $1,000 to $2,000 for final product
   - Final product market value of approximately $10,000

Miscellaneous

a. Patient-related Concerns

- Accommodate adult of average height and weight (not for children)
- Be comfortable for patient unable to provide feedback because unconscious

b. Competition
   - Previous projects have produced positioning devices, but none were motorized
   - Individual components of this semester's design may already have patents (motors, actuators, etc)
   - Patent searches yielded no existing devices with same specifications